

(12) UK Patent Application (19) GB (11) 2 286 647 (13) A

(43) Date of A Publication 23.08.1995

(21) Application No 9501764.6

(22) Date of Filing 30.01.1995

(30) Priority Data

(31) 9402678
9403226

(32) 11.02.1994
19.02.1994

(33) GB

(71) Applicant(s)
Stena Offshore Limited

(Incorporated in the United Kingdom)

Stena House, Westhill Industrial Estate, Westhill,
ABERDEEN, AB32 6TQ, United Kingdom

(72) Inventor(s)
Robert George Martin

(74) Agent and/or Address for Service
Murgitroyd & Company
373 Scotland Street, GLASGOW, G5 8QA,
United Kingdom

(51) INT CL⁶
F16L 1/20

(52) UK CL (Edition N)
F2P PL2 P37
B3E ECB E14K E15T

(56) Documents Cited
GB 1599865 A US 3872680 A US 3237438 A

(58) Field of Search
UK CL (Edition N) B3E ECB , F2P PL2 P2A1
INT CL⁶ F16L 1/12 1/16 1/18 1/20
ONLINE:WPI

(54) Pipeline straightening apparatus

(57) Pipeline straightening apparatus comprises a first, main straightening roll assembly (26) facing one side of the pipeline (12), a second straightening roll assembly (28) located upstream of the main roll (26) facing the opposite side of the pipeline (12), and a third straightening roll assembly (30) located downstream of the main roll (26) also facing said opposite side of the pipeline (12), said straightening rolls being operable to effect straightening of the pipeline passing therebetween. The apparatus includes pipeline clamping/braking means comprising a brake shoe (32) located between said second and third straightener rolls (28, 30) on the opposite side of said pipeline path from said main straightener roll (26) and actuator means (46, 48) adapted for moving the shoe (32) in a direction substantially perpendicular to the pipeline path towards and away from the pipeline; and/or each of said first, second and third roll assemblies being mounted in a supporting frame for pivotable movement about respective first, second and third pivot axes (34, 36, 38) extending substantially through the longitudinal centres of the respective roll assemblies and substantially at right angles to the plane of pipeline bending.

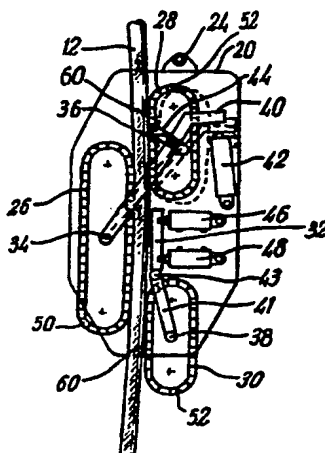


FIG. 4

1/4

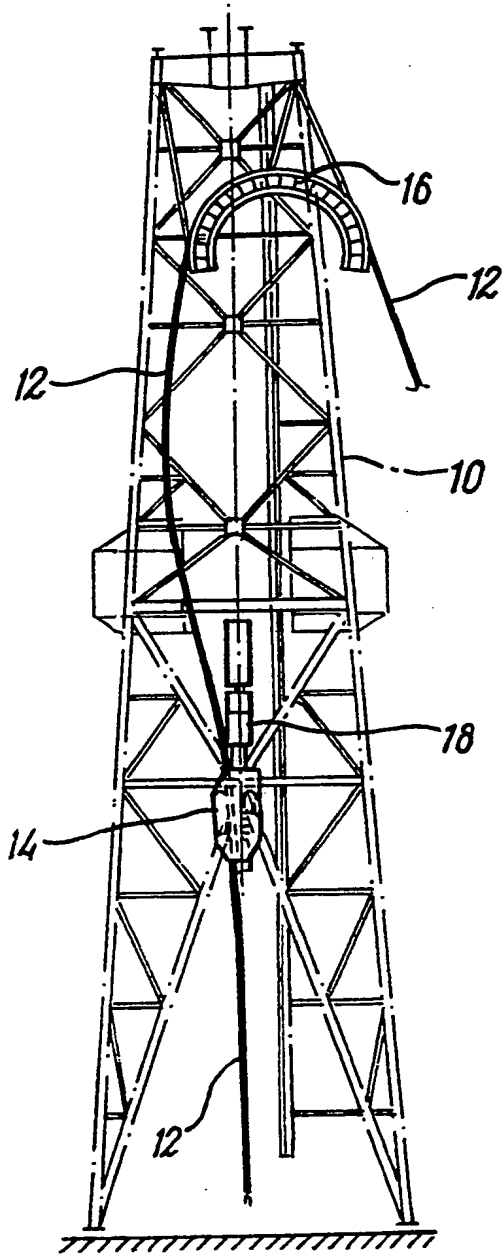


FIG. 1

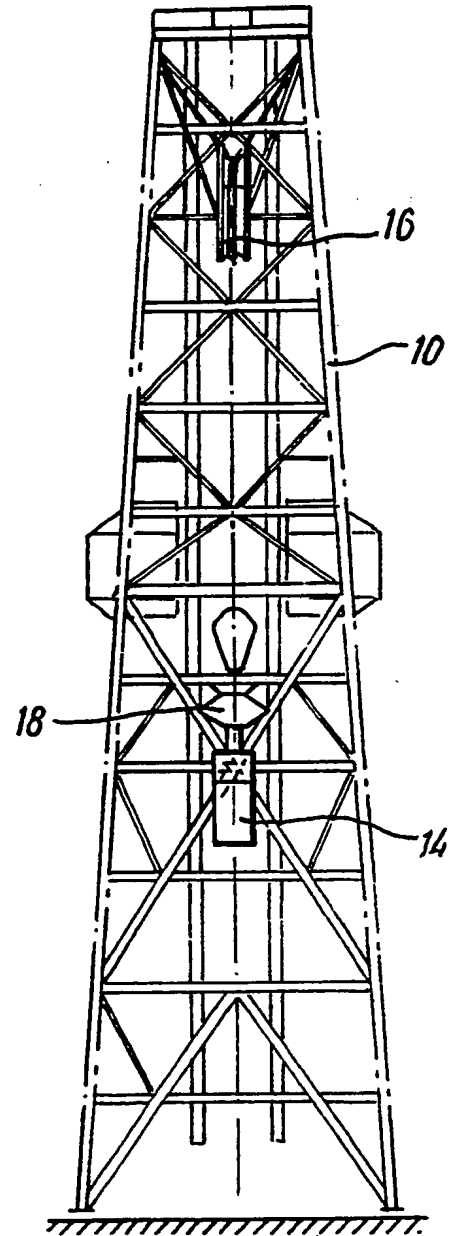


FIG. 2

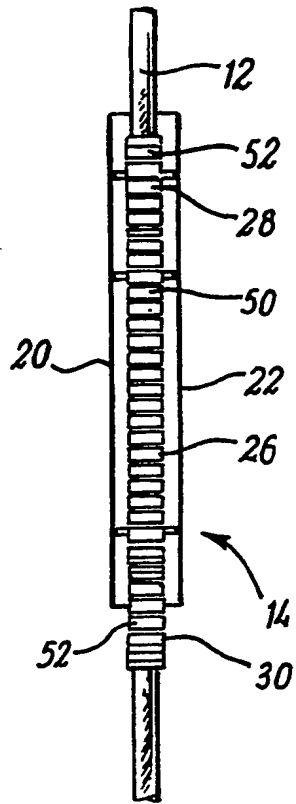


FIG. 3

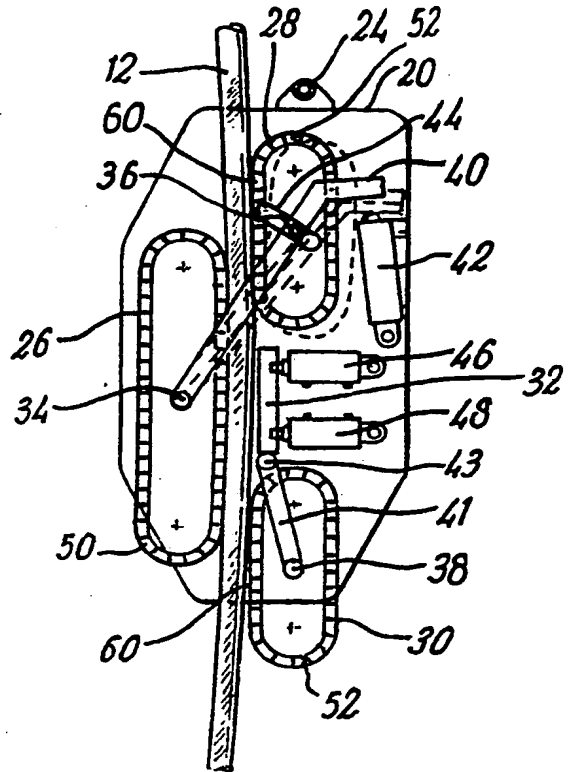


FIG. 4

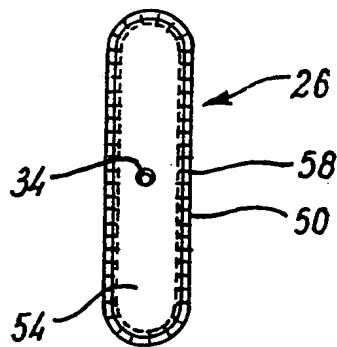


FIG. 5

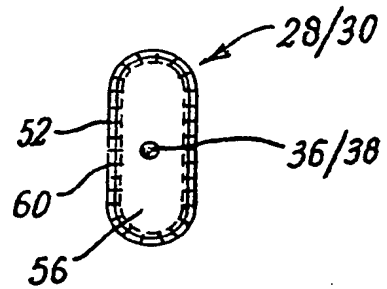


FIG. 6

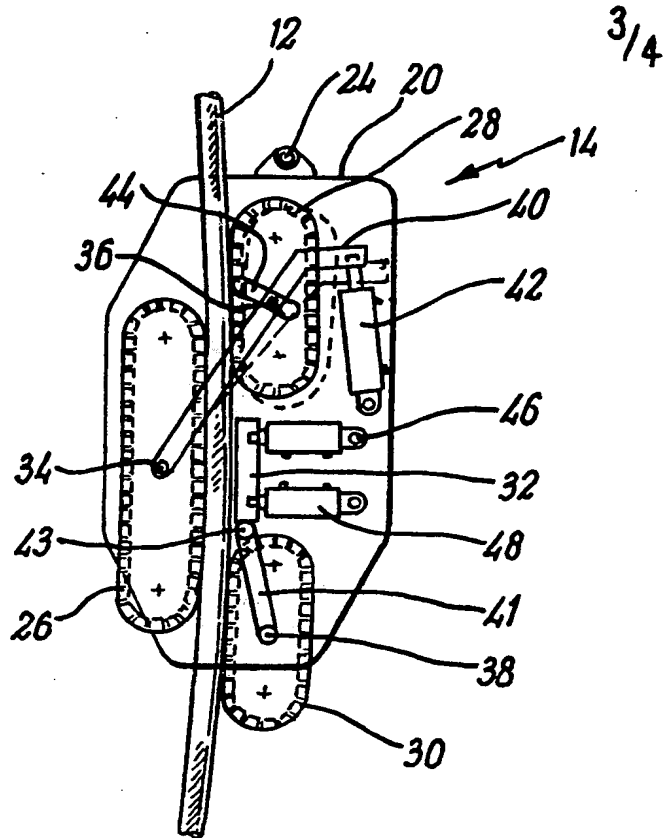


FIG. 7

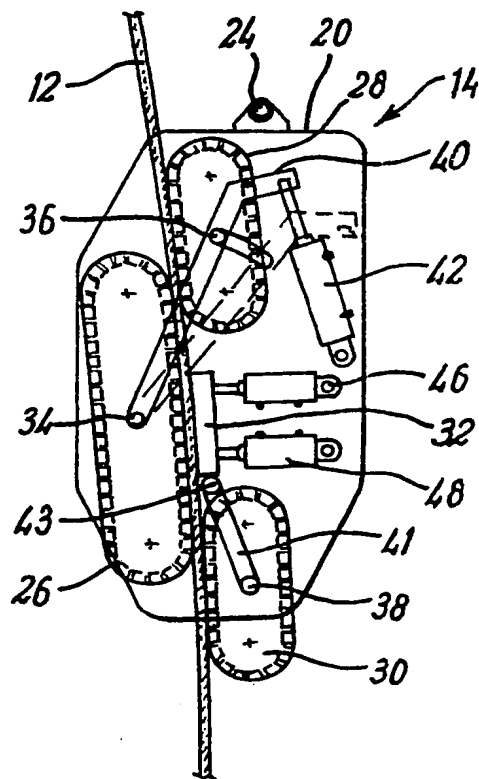


FIG. 8

4/4

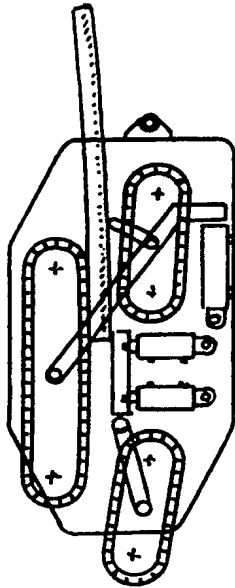


Fig. 9a

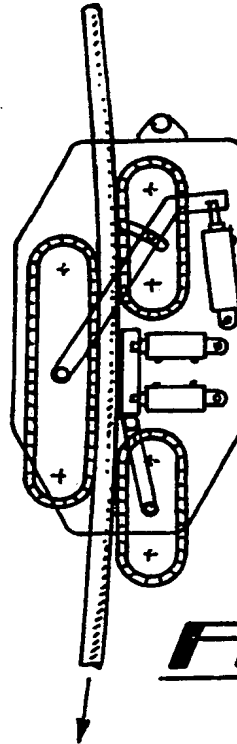


Fig. 9b

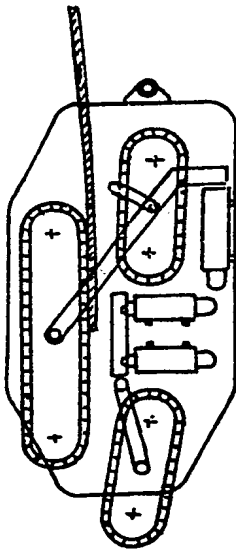


Fig. 10a

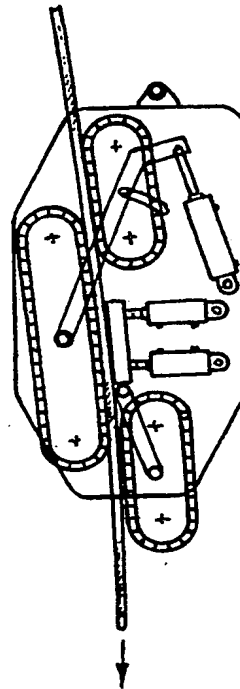


Fig. 10b

1 Improvements in or relating to Pipeline Straightening

2

3 The present invention relates to apparatus for
4 straightening rigid walled pipeline, such as steel
5 pipeline in marine pipelaying operations, which has
6 been plastically deformed; e.g. by spooling onto a
7 storage reel or by bending about a diverter shoe or the
8 like in the course of a laying operation.

9

10 The apparatus and methods disclosed herein are
11 particularly, but not exclusively, applicable for use
12 in the context of the pipelaying apparatus and methods
13 disclosed in the present applicant's co-pending UK
14 Patent Application No. 9322424.4, filed 30 October
15 1993. This prior Application discloses a pipelaying
16 system whereby a drilling vessel may be adapted for
17 pipelaying operations by means of a pipe storage reel
18 mounted on its deck, a pipeline diverter shoe located
19 at a height on the drilling derrick and a straightener
20 assembly suspended from the derrick below the diverter
21 shoe, whereby the pipeline may be straightened and laid
22 via the moonpool of the vessel. This arrangement allows
23 the same vessel to be used for both drilling and
24 pipelay operations, providing the possibility of

1 exploitation of marginal hydrocarbon deposits.

2

3 Figs. 1 and 2 of the accompanying drawings show the
4 derrick 10 of a drilling vessel adapted for pipelaying
5 operations as described above. The pipeline 12 to be
6 laid is fed from a storage reel (not shown), about an
7 arcuate diverter shoe 16 mounted at a height on the
8 derrick 10, and through a straightener assembly 14,
9 embodying the present invention, which is suspended
10 from existing crane hook 18 below the diverter shoe 16.
11 The straightener assembly 14 may be raised and lowered
12 by means of the crane hook 18 between an uppermost
13 position adjacent the diverter shoe 16 and a lowermost
14 position at the mouth of the moonpool (not shown) at
15 the bottom of the derrick 10.

16

17 The apparatus operates to straighten the pipeline 12 as
18 follows:

19

20 Firstly, with the straightening assembly 14 open and at
21 its uppermost position, a tugger cable (not shown) is
22 fed from a tugger winch (not shown, mounted below
23 deck), through a pipeline clamp (not shown, mounted in
24 the moonpool) and the straightening assembly 14, and
25 around the diverter shoe 16 for attachment to the free
26 end of the pipeline 12 emerging from the storage reel.
27 The tugger winch is then operated to pull the cable and
28 pipeline 12 over the shoe 16, and through the
29 straightener 14 until the pipeline 12 protrudes
30 approximately 5 metres below the straightener 14, at
31 which point the tugger cable is disconnected.

32

33 The straightener 14 is closed and clamped to the
34 pipeline 12 and is lowered to its lowermost position,
35 where it is clamped by the pipeline clamp, and an

1 initiation cable (not shown) is attached. The
2 straightener 14 is then unclamped from the pipeline 12,
3 and is returned to its uppermost position, thereby
4 straightening the length of pipe extending between the
5 uppermost and lowermost positions (typically a length
6 of about 24 metres).
7

8 The clamp is released, the straightener 14 is again
9 clamped to the pipeline 12 and lowered therewith to its
10 lowermost position, the clamp re-engages the pipeline
11 12, the straightener 14 is unclamped, and returned to
12 its uppermost position to straighten the next length of
13 pipe.
14

15 This cycle of operations is repeated until the free end
16 of the pipe achieves vertical stab-in of the initiation
17 head at a stab-in assembly located on the sea bed,
18 guided by the initiation cable, which extends from the
19 end of the pipe 12, through the stab-in assembly and
20 back to an abandonment and recovery winch (not shown,
21 mounted below deck). Once stab-in is achieved the
22 initiation cable is detached and the vessel proceeds
23 with the pipelay, straightening the pipeline 12 as it
24 is unspooled from the reel in the same manner as
25 described above.
26

27 The pipeline straightening technique described above is
28 as disclosed in UK Patent Application No. 9322424.4,
29 wherein the straightener assembly may be any one of a
30 number of known types.
31

32 The present invention provides a pipe straightening
33 arrangement which is particularly suited for use in a
34 pipelaying system of the type described above, and
35 which may also find application in other situations

1 where pipeline straightening is required.

2
3 In accordance with the invention there is provided
4 pipeline straightening apparatus comprising a first,
5 main straightening roll assembly having a pipeline
6 contacting surface facing one side of the pipeline, in
7 use, a second straightening roll assembly located
8 upstream relative to the main roll in the pipeline
9 feeding direction and having a pipeline contacting
10 surface facing the opposite side of the pipeline, in
11 use, and a third straightening roll assembly located
12 downstream relative to the main roll in the pipeline
13 feeding direction and having a pipeline contacting
14 surface also facing said opposite side of the pipeline,
15 said first, second and third straightening rolls being
16 operable to engage a pipeline passing therebetween in
17 order to effect straightening of said pipeline; said
18 apparatus further including pipeline clamping/braking
19 means comprising at least one brake shoe located
20 between said second and third straightener rolls on the
21 opposite side of said pipeline path from said main
22 straightener roll and actuator means adapted for moving
23 said shoe in a direction substantially perpendicular to
24 said pipeline path towards and away from the pipeline
25 contacting surface of said main straightener roll.

26
27 Preferably, each of said first, second and third roll
28 assemblies are mounted in a supporting frame for
29 pivotable movement about respective first, second and
30 third pivot axes extending substantially through the
31 longitudinal centres of the respective roll assemblies
32 and substantially at right angles to the plane of
33 pipeline bending.

34
35 Preferably also, said supporting frame comprises first

1 and second side plates disposed in spaced,
2 substantially parallel relationship, said straightener
3 rolls and clamping/braking means being located
4 therebetween.

5
6 Preferably also, said second, upstream roll assembly is
7 further adapted for pivotable movement about a fourth
8 axis located away from the longitudinal centre thereof
9 and extending substantially at right angles to the
10 plane of pipeline bending whereby the position of said
11 second roll may be adjusted relative to the pipeline
12 path.

13
14 Preferably also, said fourth axis is coincident with
15 said first axis, said second roll being mounted between
16 first and second swing arms for pivotable movement
17 about said second axis and said swing arms being
18 mounted for pivotable movement about said fourth axis.

19
20 Preferably also, the position of said second roll
21 relative to said pipeline path is controlled by
22 actuator means operably connected to said swing arms.

23
24 Preferably also, said brake shoe is pivotably connected
25 at a lowermost end thereof about a fifth pivot axis
26 between first ends of third and fourth swing arms
27 disposed on either side of said third straightener
28 roll, second ends of said third and fourth swing arms
29 being pivotable about said third pivot axis.

30
31 Preferably also, said pipeline contacting surface of
32 said main roll assembly is arcuate in longitudinal
33 profile.

34
35 Preferably also, said pipeline contacting surfaces of

1 said second and third rolls are substantially
2 rectilinear in longitudinal profile.

3
4 In accordance with a second aspect of the invention
5 there is provided pipeline straightening apparatus
6 comprising a first, main straightening roll assembly
7 having a pipeline contacting surface facing one side of
8 the pipeline, in use, a second straightening roll
9 assembly located upstream relative to the main roll in
10 the pipeline feeding direction and having a pipeline
11 contacting surface facing the opposite side of the
12 pipeline, in use, and a third straightening roll
13 assembly located downstream relative to the main roll
14 in the pipeline feeding direction and having a pipeline
15 contacting surface also facing said opposite side of
16 the pipeline, said first, second and third
17 straightening rolls being operable to engage a pipeline
18 passing therebetween in order to effect straightening
19 of said pipeline; each of said first, second and third
20 roll assemblies being mounted in a supporting frame for
21 pivotable movement about respective first, second and
22 third pivot axes extending substantially through the
23 longitudinal centres of the respective roll assemblies
24 and substantially at right angles to the plane of
25 pipeline bending.

26
27 Preferably, said apparatus further includes pipeline
28 clamping/braking means comprising at least one brake
29 shoe located between said second and third straightener
30 rolls on the opposite side of said pipeline path from
31 said main straightener roll and actuator means adapted
32 for moving said shoe in a direction substantially
33 perpendicular to said pipeline path towards and away
34 from the pipeline contacting surface of said main
35 straightener roll.

1 Further preferred features of the second aspect of the
2 invention are the same as defined above in relation to
3 the first aspect.

4
5 An embodiment of the invention will now be described,
6 by way of example only, with reference to the
7 accompanying drawings, in which:

8
9 Fig. 1 is a first side view of pipeline
10 straightening apparatus embodying the
11 invention suspended from the derrick of a
12 drilling vessel adapted for pipeline laying
13 operations, viewed in a direction
14 perpendicular to the plane of pipeline
15 bending;

16
17 Fig. 2 is a second side view of the apparatus
18 and derrick of Fig. 1 viewed along the plane
19 of pipeline bending;

20
21 Fig. 3 is a first schematic side view of the
22 apparatus of Fig. 1 viewed along the plane of
23 pipeline bending;

24
25 Fig. 4 is a second schematic side view of the
26 apparatus of Fig 1 viewed in a direction
27 perpendicular to the plane of pipeline
28 bending;

29
30 Fig. 5 is a side view of a roller track
31 assembly being the first of three
32 straightening rolls of the apparatus of Figs.
33 1 to 4;

34
35 Fig. 6 is a side view of a roller track

1 assembly used for the second and third of the
2 three straightening rolls of Figs 1 to 4;

3
4 Fig. 7 is a side view of the apparatus
5 similar to that of Fig. 4 engaging a first
6 pipeline of relatively large diameter;

7
8 Fig. 8 is a side view of the apparatus
9 similar to that of Fig. 4 engaging a first
10 pipeline of relatively small diameter;

11
12 Figs. 9(a) and 9(b) are side views similar to
13 Fig. 7 showing the operation of the apparatus
14 with a pipeline of relatively large diameter;
15 and

16
17 Figs. 10(a) and 10(b) are side views similar
18 to Fig. 8 showing the operation of the
19 apparatus with a pipeline of relatively small
20 diameter.

21
22 Referring now to the drawings, Figs. 1 and 2 show a
23 pipeline straightening apparatus 14 embodying the
24 invention installed as part of a pipelaying system as
25 described above. The purpose of the straightener
26 assembly 14 is to impart a reverse bending force to the
27 pipeline 12 sufficient to overcome the curvature
28 imparted to the pipeline 12 by plastic deformation
29 thereof during spooling onto the storage reel and/or
30 bending around the diverter shoe 16. For this purpose
31 three reaction points are required to be exerted on the
32 pipe, the two end points acting in one direction and
33 the intermediate point acting in the opposite
34 direction, such that all three forces are substantially
35 co-planar in the plane of bending.

1 A variety of "three-point straighteners" of this
2 general type are known from the prior art, for example
3 from US Patents Nos. 3,237,438; 3,641,778; 3,680,342;
4 3,712,100; 3,855,835; 3,982,402 (RE 30,846); 4,157,023;
5 4,230,421; 4,243,345; 4,260,287; 4,260,287 and
6 4,687,376. These prior art straighteners generally fall
7 into two categories: straighteners which use
8 arrangements of individual rollers (as seen in US
9 Patents Nos. 3,855,835; 4,157,023; 4,243,345 and
10 4,260,287), most often used in "portable reel" systems
11 where storage reels and associated apparatus for laying
12 relatively small diameter pipes are temporarily
13 installed on existing vessels; and "roller track" type
14 straighteners which use up to five caterpillar type
15 track assemblies for straightening and/or tensioning
16 relatively large pipelines on purpose-built or
17 permanently adapted vessels (as seen, for example, in
18 US Patents Nos. 3,680,342; 3,982,402 (RE 30,846);
19 4,230,421; 4,269,540 and 4,687,376). The present
20 invention is concerned with the latter roller track
21 type of straightener. Reference is made particularly to
22 US Patent No. 3,680,342 for a detailed disclosure of
23 roller track assemblies of the type employed in such
24 straightener systems, and suitable also for use in the
25 present invention. Further reference will be made to
26 particular details of such roller track assemblies in
27 the course of the following description.

28
29 Referring now to Figs. 3 to 6 of the drawings,
30 straightener apparatus 14 embodying the invention
31 comprises a self-contained assembly in which all of the
32 major components are mounted between first and second
33 side plates 20, 22, the assembly 14 having a padeye 24
34 located at an upper end thereof whereby it may be
35 suspended in use, for example from the crane hook 18 of

1 the derrick 10 as seen in Figs. 1 and 2. The main
2 components of the apparatus comprise a first, main
3 roller track assembly, or "straightening roll", a
4 second, upper roller track assembly 28, a third, lower
5 roller track assembly 30 and a pipeline
6 braking/clamping shoe 32. In use, the pipeline 12
7 passes through the assembly 14 between the main roll
8 26, disposed on one side of the pipeline path, and the
9 upper and lower rolls 28, 30 disposed on the opposite
10 side of the pipeline path and respectively upstream and
11 downstream of the main roll 26 in the direction of
12 pipeline unspooling. The braking/clamping shoe 32 is
13 located between the upper and lower straightener rolls
14 28, 30, facing the pipeline contacting surface of the
15 main roll 26.

16
17 Each of the first, second and third straightener rolls
18 26, 28, 30 are mounted for pivotable movement about
19 respective pivot axes 34, 36, 38, extending
20 substantially through the longitudinal centres of the
21 respective straightener rolls 26, 28, 30 perpendicular
22 to the plane of pipeline curvature (i.e. perpendicular
23 to the side plates 20, 22).

24
25 The first and third straightener rolls 26, 30 are
26 pivotably mounted between the side plates 20, 22. The
27 second roll 28 is pivotably mounted between a pair of
28 swing arms 40, of which only one is visible in the
29 drawings, the swing arms 40 themselves being pivotable
30 about a fourth pivot axis, which is conveniently
31 coincident with the first pivot axis 34 of the first
32 roll 26. The first and third rolls 26, 30 are thus
33 pivotably movable about their respective pivot axes 34,
34 38, whilst the second roll is pivotable about its pivot
35 axis 36 and movable towards and away from the pipeline

1 path by pivoting movement of the swing arms 40 about
2 the first axis 34.

3
4 In order to effect adjustment of the position of the
5 second roll 28 relative to the pipeline path, a
6 hydraulic or pneumatic cylinder 42, or other suitable
7 actuator means, is mounted between the side plates 20,
8 22, with its working end connected to the free ends of
9 the swing arms 40 remote from their pivot axis 34. The
10 central pivot pin of the second straightener roll 28
11 extends into arcuate guide slots 44 formed in the side
12 plates 20, 22, of which only one is visible in the
13 drawings, to guide and limit the movement of the swing
14 arms 40.

15
16 The position of the swing arm pivot axis may be varied
17 from that shown. It is generally desirable for the axis
18 to be downstream of the second roll 28 on the opposite
19 side of the pipeline path therefrom, and to be at a
20 sufficient distance from the second roll 28 to provide
21 a reasonable lever arm. It is structurally convenient
22 and advantageous for the swing arms 40 to pivot about
23 the same axis as the main roll 26, but this is not
24 essential to the operation of the apparatus.

25
26 The braking/clamping shoe 32 is mounted on second and
27 third hydraulic or pneumatic cylinders 46, 48 mounted
28 between the side plates 20, 22, or other suitable
29 actuator means, for movement in a direction
30 substantially perpendicular to the pipeline path in the
31 plane of pipeline bending. The lowermost end of the
32 brake shoe 32 is pivotably connected about a fifth
33 pivot axis 43 between first ends of a further pair of
34 swing arms 41, of which only one is visible in the
35 drawings, the other ends of the swing arms 41, which

1 are disposed on either side of the third straightener
2 roll 30, are pivoted about the third pivot axis 38
3 about which the third roll 30 itself pivots.

4
5 As previously indicated, the straightener rolls 26, 28
6 and 30 are of a generally known type, comprising an
7 endless caterpillar type roller track 50, 52 rotatable
8 around the periphery of a supporting structure 54, 56.
9 The tracks 50, 52 each comprise a plurality of linked
10 blocks having a transverse arcuate or v-shaped profile
11 (not shown) for seating against the pipeline surface.
12 The pipe contacting portions of the blocks may be faced
13 with polyurethane or the like to protect the pipeline.
14 Reference is made to US Patent No. 3,680,342 for a more
15 detailed discussion of these and other aspects of
16 straightener rolls of this type. It should also be
17 understood that the caterpillar tracks 50, 52 might be
18 replaced by a series of discrete rollers rotatably
19 mounted in the support structures 54, 56 along the
20 pipeline facing side thereof, as is also known in the
21 art.

22
23 The braking/clamping shoe 32 may have a similar
24 configuration to one of the blocks of the caterpillar
25 tracks 50, 52, but being relatively larger,
26 particularly in terms of longitudinal length.

27
28 The main straightener roll 26 is generally longer than
29 the second and third rolls 28, 30, and the pipe
30 contacting face 58 thereof is preferably arcuate in
31 longitudinal profile. The radius of longitudinal
32 curvature of the face 58 may be fixed at a value which
33 suits a range of pipeline diameters, or the roll
34 assembly may be adapted to allow variation of the
35 radius of curvature so as to be optimised for

1 particular pipeline diameters. A straightener roll
2 having variable curvature is disclosed in US Patent No.
3 4,687,376. The second and third straightener rolls 28,
4 30 are relatively shorter than the main roll 26 and
5 their pipeline contacting faces are substantially
6 rectilinear in longitudinal profile.

7
8 The braking/clamping shoe 32, in cooperation with the
9 main roll 26, performs pipeline clamping and braking
10 functions, so that the straightener rolls 26, 28 and 30
11 may be unpowered (i.e. their tracks or rollers do not
12 have to be driven) and only the second roll 28 need be
13 movable relative to the pipeline path so as to adjust
14 the apparatus for straightening pipelines of different
15 diameters. Prior art straighteners include adjustable,
16 powered straightener rolls which may perform clamping
17 and tensioning/braking functions in addition to
18 straightening. The present apparatus provides a
19 simplified arrangement which is less costly to
20 construct and which is relatively simpler and quicker
21 to set up in comparison with prior art systems.

22
23 In use of the present apparatus in the pipelaying
24 system illustrated in Figs. 1 and 2, the
25 braking/clamping shoe 32 serves firstly for clamping
26 the pipeline 12 while the straightener is initially
27 lowered from its upper position to its lower position,
28 and subsequently to tension the pipeline during the
29 straightening phase of each cycle of operation.

30
31 Figs. 7 and 8 show side views of the apparatus of Figs.
32 3 to 6 adjusted for six inch and two inch diameter
33 pipelines respectively by appropriate adjustment of the
34 pistons of the roll and brake shoe cylinders 42, 46,
35 48. The relative positions of the second straightener

1 roll 28, swing arms 40 and brake shoe 32 can be seen by
2 comparison of the drawings. Figs. 9 and 10 show the
3 "snap-action" operation of the apparatus in engaging
4 the pipeline after initial feeding through the
5 apparatus, again for six and two inch diameter
6 pipelines respectively. In each case the second roll 28
7 and brake shoe 32 are initially retracted clear of the
8 pipeline path, allowing the pipeline 12 to be fed
9 through the apparatus. The first cylinder 42 and the
10 brake cylinders 48, 50 are then operated to bring the
11 second roll 28 and brake shoe 32 into engagement with
12 the pipeline 12 as required. The three straightener
13 rolls 26, 28, 30 pivot about their respective axes to
14 orient themselves with the pipeline.

15
16 The straightening apparatus as herein described has
17 significant advantages in terms of its simplicity of
18 construction and operation, and its configuration as a
19 relatively compact, self-contained assembly is
20 advantageous, being readily portable for installation
21 as part of the temporary adaptation of a vessel for
22 pipelaying operations and requiring external power
23 supplies only for the swing arm and brake shoe
24 actuators.

25
26 Improvements and modifications may be incorporated
27 without departing from the scope of the invention.

28

1 Claims

2
3 1. Pipeline straightening apparatus comprising a
4 first, main straightening roll assembly having a
5 pipeline contacting surface facing one side of the
6 pipeline, in use, a second straightening roll assembly
7 located upstream relative to the main roll in the
8 pipeline feeding direction and having a pipeline
9 contacting surface facing the opposite side of the
10 pipeline, in use, and a third straightening roll
11 assembly located downstream relative to the main roll
12 in the pipeline feeding direction and having a pipeline
13 contacting surface also facing said opposite side of
14 the pipeline, said first, second and third
15 straightening rolls being operable to engage a pipeline
16 passing therebetween in order to effect straightening
17 of said pipeline; said apparatus further including
18 pipeline clamping/braking means comprising at least one
19 brake shoe located between said second and third
20 straightener rolls on the opposite side of said
21 pipeline path from said main straightener roll and
22 actuator means adapted for moving said shoe in a
23 direction substantially perpendicular to said pipeline
24 path towards and away from the pipeline contacting
25 surface of said main straightener roll.

26
27 2. Pipeline straightening apparatus as claimed in
28 Claim 1, wherein each of said first, second and third
29 roll assemblies are mounted in a supporting frame for
30 pivotable movement about respective first, second and
31 third pivot axes extending substantially through the
32 longitudinal centres of the respective roll assemblies
33 and substantially at right angles to the plane of
34 pipeline bending.

35

1 3. Pipeline straightening apparatus comprising a
2 first, main straightening roll assembly having a
3 pipeline contacting surface facing one side of the
4 pipeline, in use, a second straightening roll assembly
5 located upstream relative to the main roll in the
6 pipeline feeding direction and having a pipeline
7 contacting surface facing the opposite side of the
8 pipeline, in use, and a third straightening roll
9 assembly located downstream relative to the main roll
10 in the pipeline feeding direction and having a pipeline
11 contacting surface also facing said opposite side of
12 the pipeline, said first, second and third
13 straightening rolls being operable to engage a pipeline
14 passing therebetween in order to effect straightening
15 of said pipeline; each of said first, second and third
16 roll assemblies being mounted in a supporting frame for
17 pivotable movement about respective first, second and
18 third pivot axes extending substantially through the
19 longitudinal centres of the respective roll assemblies
20 and substantially at right angles to the plane of
21 pipeline bending.

22
23 4. Pipeline straightening apparatus as claimed in
24 Claim 3, further including pipeline clamping/braking
25 means comprising at least one brake shoe located
26 between said second and third straightener rolls on the
27 opposite side of said pipeline path from said main
28 straightener roll and actuator means adapted for moving
29 said shoe in a direction substantially perpendicular to
30 said pipeline path towards and away from the pipeline
31 contacting surface of said main straightener roll.

32
33 5. Pipeline straightening apparatus as claimed in
34 Claim 2, Claim 4, wherein said supporting frame
35 comprises first and second side plates disposed in

1 spaced, substantially parallel relationship, said
2 straightener rolls and clamping/braking means being
3 located therebetween.
4

5 6. Pipeline straightening apparatus as claimed in any
6 one of Claims 2, 3, 4 or 5, wherein said second,
7 upstream roll assembly is further adapted for pivotable
8 movement about a fourth axis located away from the
9 longitudinal centre thereof and extending substantially
10 at right angles to the plane of pipeline bending
11 whereby the position of said second roll may be
12 adjusted relative to the pipeline path.
13

14 7. Pipeline straightening apparatus as claimed in
15 Claim 6, wherein said fourth axis is coincident with
16 said first axis, said second roll being mounted between
17 first and second swing arms for pivotable movement
18 about said second axis and said swing arms being
19 mounted for pivotable movement about said fourth axis.
20

21 8. Pipeline straightening apparatus as claimed in
22 Claim 7, wherein the position of said second roll
23 relative to said pipeline path is controlled by
24 actuator means operably connected to said swing arms.
25

26 9. Pipeline straightening apparatus as claimed in
27 Claim 7 or Claim 8 when dependent from Claim 2, Claim 4
28 or Claim 5, wherein said brake shoe is pivotably
29 connected at a lowermost end thereof about a fifth
30 pivot axis between first ends of third and fourth swing
31 arms disposed on either side of said third straightener
32 roll, second ends of said third and fourth swing arms
33 being pivotable about said third pivot axis.
34

35 10. Pipeline straightening apparatus as claimed in any

1 preceding Claim, wherein said pipeline contacting
2 surface of said main roll assembly is arcuate in
3 longitudinal profile.
4

5 11. Pipeline straightening apparatus as claimed in any
6 preceding Claim, wherein said pipeline contacting
7 surfaces of said second and third rolls are
8 substantially rectilinear in longitudinal profile.
9

10 12. Pipeline straightening apparatus substantially as
11 hereinbefore described with reference to the
12 accompanying drawings.
13

Relevant Technical Fields

(i) UK Cl (Ed.N) F2P PL2, P2A1, B3E ECB

(ii) Int Cl (Ed.6) F16L 1/20 1/12, 1/16, 1/18

Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Search Examiner
 MR S WALLER

Date of completion of Search
 17 MAY 1995

Documents considered relevant
 following a search in respect of
 Claims :-
 1-12

Categories of documents

- X:** Document indicating lack of novelty or of inventive step. **P:** Document published on or after the declared priority date but before the filing date of the present application.
- Y:** Document indicating lack of inventive step if combined with one or more other documents of the same category. **E:** Patent document published on or after, but with priority date earlier than, the filing date of the present application.
- A:** Document indicating technological background and/or state of the art. **&:** Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1599865	(SANTA FE) see Figure 5B	3
X	US 3872680	(BROWN & ROOT) see Figures 3 and 4	3, 10
X	US 3237438	(TESSON) see Figures 3 and 4	3, 11

RECEIVED
 APR 17 2001
 TC 3600 MAIL ROOM

